

Transport Layer, Part 1

Introduction

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Transport Layer

- ❑ Basic purpose: moving data from one application (or process) to a remote application
- ❑ Functions:
 - Connection management
 - Packetization and reassembly of application data
 - Error control
 - Reliability
 - Flow control
 - Congestion control (in Internet)

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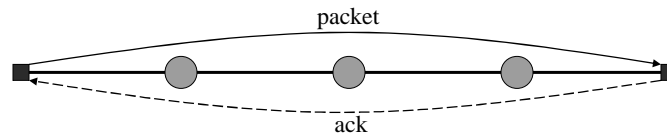
Contrasting with DLL

- ❑ In the OSI model, both the transport layer and DLL provide flow control and error control.
- ❑ When the flow/error control is performed by the transport layer, it is called **end-to-end** control.
- ❑ When the flow/error control is performed by the DLL, it is called **per-hop** control.

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End-to-End Control

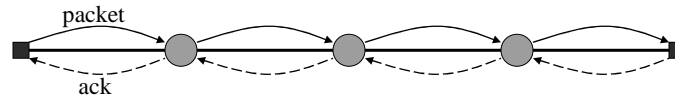


- ❑ The delivery of frames across links is assumed unreliable.
- ❑ Imposes low overhead
- ❑ Works well when links along the delivery path is of high quality (low error rate).
- ❑ Wastes bandwidth when, for example, errors occur in the first hop (because corrupted data still transmitted over following links).

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Per-Hop Control



- ❑ Enforcing flow/error control over every link
- ❑ Imposes unnecessary overhead over high-quality links
- ❑ Works well with error-prone links

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Task Division in Internet

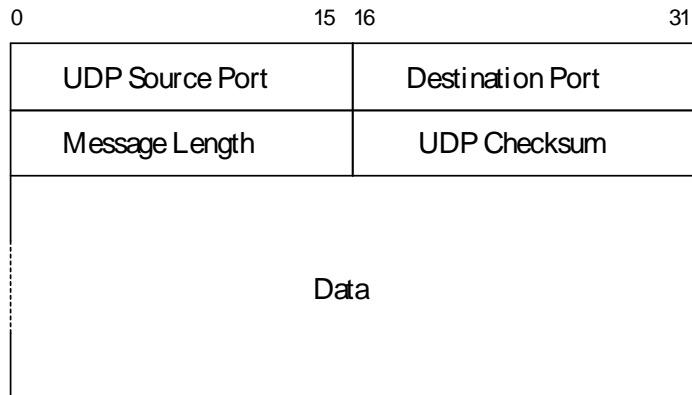
- ❑ Internet is a technology that interconnects different networks/DLLs, including future ones.
- ❑ It assumes a minimum feature from DLLs, the unreliable delivery of frames.
 - However, it does not exclude DLLs that perform flow/error control.
- ❑ Hence, hosts in the Internet perform flow/error control on their own (that is, end-to-end control).
- ❑ We will study the TCP sliding window protocol in detail.

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UDP: User Datagram Protocol

- ❑ Provides unreliable datagram service to applications/processes
- ❑ Format:

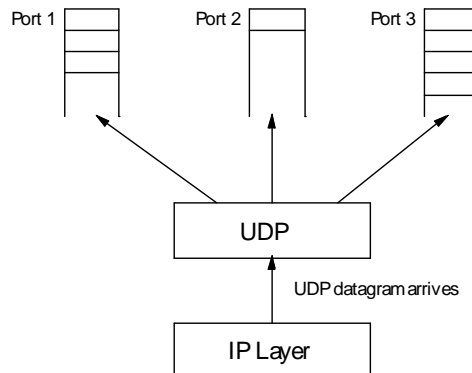


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Ports

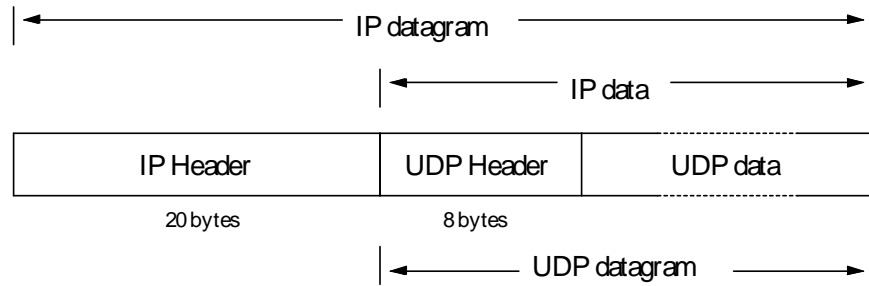
- ❑ A process obtains a port via a system call.
- ❑ Associated with each port is a queue for arriving messages.
- ❑ Ports are “rendevvous points” between applications and messages



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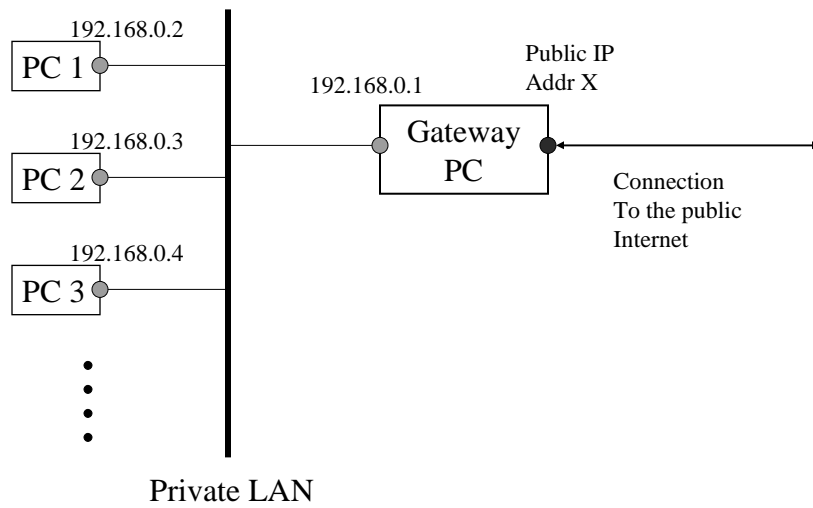
UDP Encapsulation



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IP Masquerading

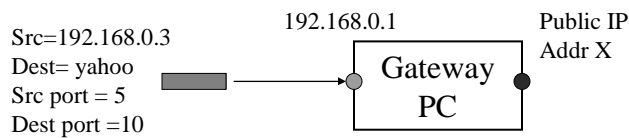


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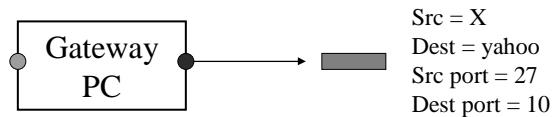
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- ❑ Allow multiple hosts in a private network to share *one* public IP addresses.
- ❑ The basic idea is that both UDP and TCP uses port numbers.
- ❑ Port numbers are local matters and 16-bit wide.
 - Usually there are plenty unused port numbers at any host.

- ❑ A packet from an internet host to yahoo.com
 - Port 5 is found available and reserved on host 192.168.0.3



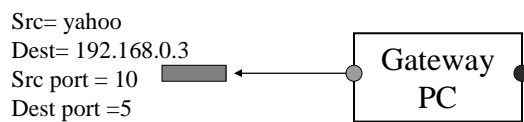
- ❑ The gateway host selects a new, locally available port number and forwards the packet with the shared public addr X and the new port number 27.
- ❑ Gateway also remembers 27 is reserved for 192.168.0.3



- ❑ The reply from yahoo arrives. The gateway PC knows it is not the final dest because of the dest port 27.



- ❑ Gateway PC relays the packet to the private LAN, replacing the dest addr with 192.168.0.3 and dest port with 5



- ❑ It is as if 192.168.0.3, a private address, can access the public internet.

Further Discussions

- ❑ For those applications that do not use a transport layer protocol (and port numbers), IP masquerading will not work.
- ❑ Such applications usually fall in the category of network management/diagnosis and are not used by average users.